

## Ultrastructural identification of folliculo-stellate cells in the pars distalis of the cat and dog pituitary gland\*

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### INTRODUCTION

In the last decade, considerable descriptive information on ultrastructural aspects of the mammalian pituitary pars distalis, especially in rodent species, has accumulated (reviewed by Girod, 1984). Relatively few papers, however, have dealt with the identification of cell types in the pars distalis of the cat and dog. Using tinctorial and/or histochemical methods, light microscopists have described various types of cell in the anterior lobe of the hypophysis in the cat (Dawson, 1946; Racadot & Herlant, 1956, 1958; Galgano & Della Corte, 1959; Della Corte, 1960; Racadot, 1961; Tavares de Sousa, 1961; Bade & Echave-Llanos, 1962; Heath, 1965; Amat, 1970; Girod, 1976) and the dog (Hartman, Fain & Wolfe, 1946; Goldberg & Chaikoff, 1952; Mikami & Ono, 1956; Purves & Griesbach, 1957; Wolfe, 1959; Carlon, 1967; Haase, 1967; Haase & Wächtler, 1968; Solcia, Capella & Vassallo, 1969; El Etreby & Tüshaus, 1973; El Etreby, Günzel & Wrobel, 1975; El Etreby & Fath El Bab, 1977; Attia, 1978; Attia & Zayed, 1979). More recently, immunocytochemical methods have been used to identify cell types in the adenohypophysis of the cat and dog (for review, see Girod, 1983). The present study of the pituitary gland has been undertaken in an attempt to establish the ultrastructural characteristics of folliculo-stellate cells in the cat and dog pars distalis.

### MATERIALS AND METHODS

Adult male and female domestic cats and Beagle dogs were used. Under Nembutal anaesthesia, pituitary glands were quickly removed and small fragments of the pars distalis were isolated.

Tissue fragments for electron microscopy were fixed in 2% glutaraldehyde in 0.2% sodium cacodylate buffer, pH 7.4, for 30 minutes to 2 hours at 4 °C. After washing in buffer overnight, they were postfixed in 1% osmium tetroxide in 0.1M cacodylate buffer. After washing in buffer (3 × 5 minutes) and dehydration in an ascending series of ethanol concentrations, specimens were embedded in Araldite. Ultrathin sections were prepared with a Reichert OMU-3 ultramicrotome and stained with uranyl acetate and lead citrate. They were examined and photographed using a Jeol JEM-7 electron microscope.

\* Reprint requests to Professor Girod.

## RESULTS

Comparison of the ultrastructural characteristics of folliculo-stellate cells in the anterior lobe of the cat and dog pituitary gland shows that there are features in common in addition to species-specific features.

*Common features*

Certain features were found which did not differ between the two sexes.

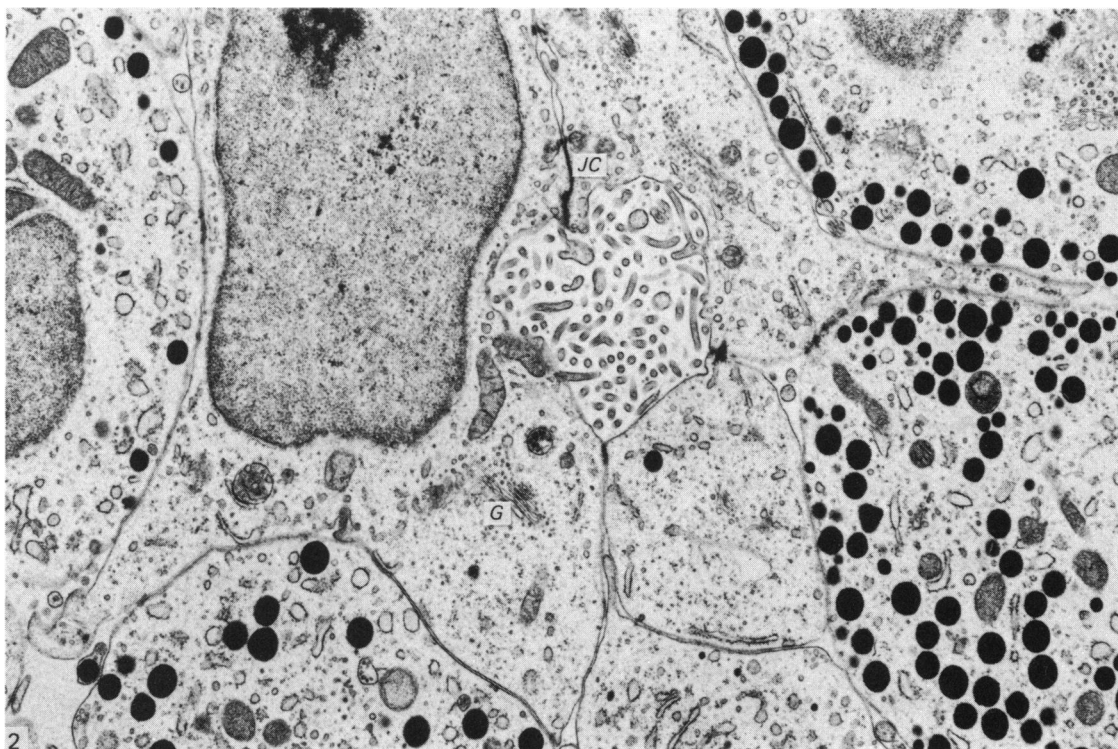
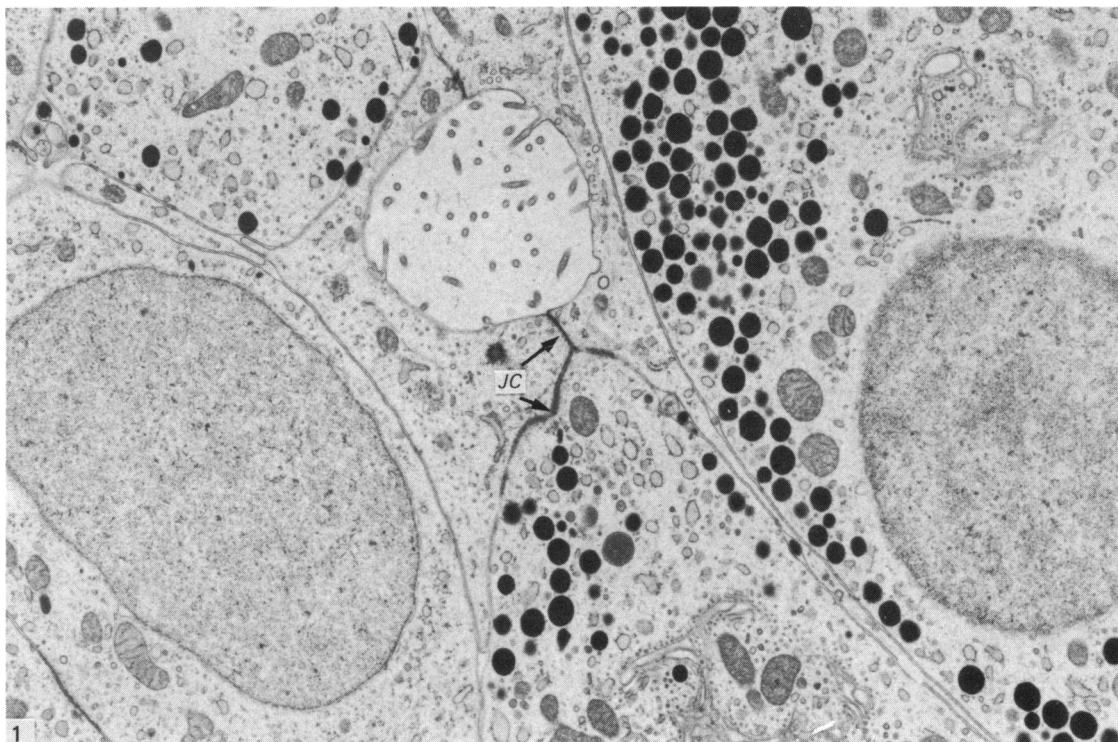
In general folliculo-stellate cells were always stellate; they were few in number and were intermingled with the endocrine cells. Long expanding cytoplasmic processes extended between some but not all granular cells of various types (somatotrophic, prolactin, 'corticotrophic' and glycoprotein secreting cells) without any special relationship to one cell or another. These processes could be very thin, only 20 nm in diameter. They reached the basal lamina which surrounded the cords of glandular cells and which separated them from the perivascular space; here the processes often enlarged to form 'end feet' or 'vascular feet' bordering the perivascular space. Two or more folliculo-stellate cells surrounded a small cavity, round or elongated in shape; in some sections, this cavity was reduced to a narrow pseudolumen; in such circumstances, interdigitations between neighbouring folliculo-stellate cells could be seen. A variable number of microvilli sectioned in various planes protruded into the follicular cavity. The latter was located in the centre of the cell cords in such a manner that no single granular cell marked the boundary of the cavity. Occasionally, isolated cilia sharing a 9+0 fibril pattern projected into the follicular cavity; in some cases transverse sections of cilia were seen in the cytoplasm.

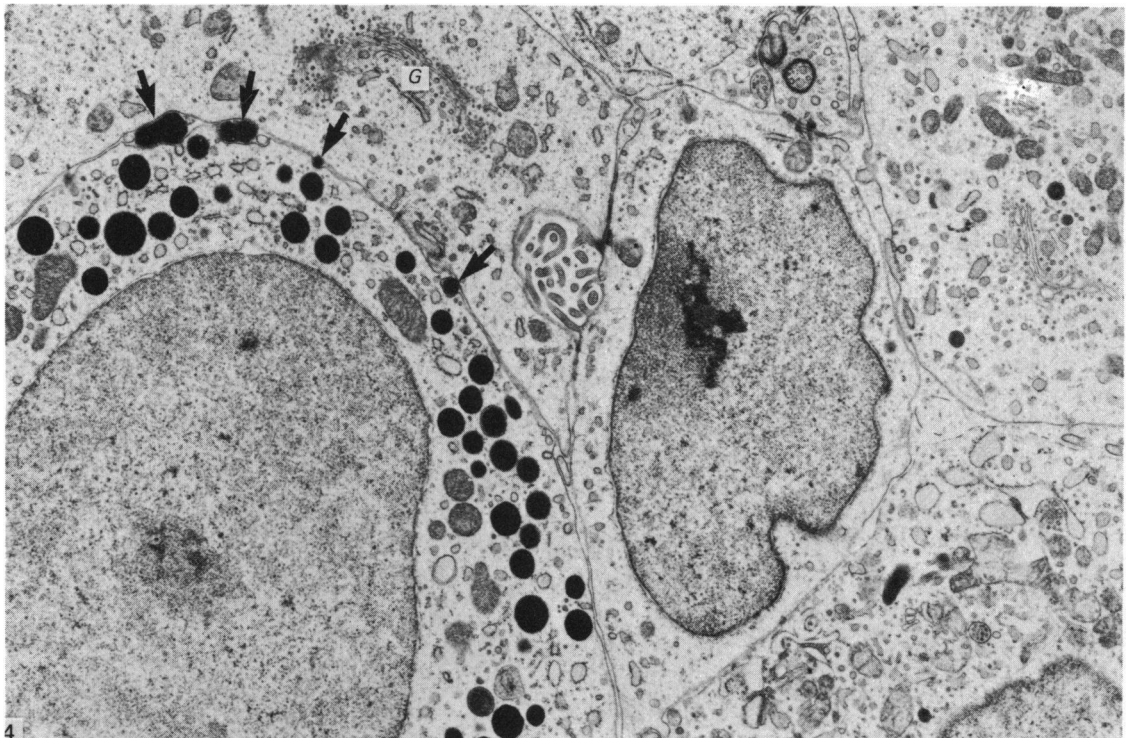
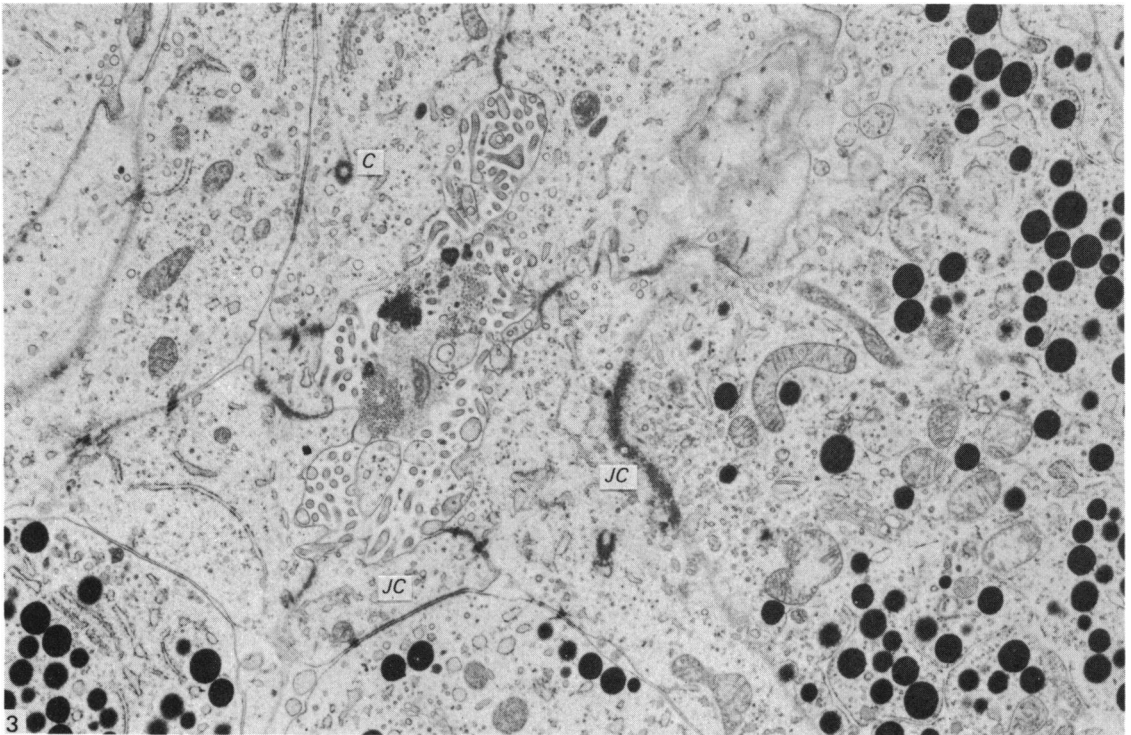
A number of common cytological features were seen. The cytoplasm was always agranular. The nucleus was variable in shape: ovoid, elongated or sometimes slightly indented. Cytoplasmic organelles were poorly developed and sparsely distributed in the cytoplasm. The juxtanuclear Golgi complex was reduced to short saccules compactly arranged and surrounded by vesicles but showed no evidence of secretory granule formation. Mitochondria, generally round in shape, were scattered throughout the cytoplasm. Granular endoplasmic reticulum was limited to small isolated cisternae while the agranular endoplasmic reticulum was sparse; free ribosomes, polysomes, lysosome-like bodies and lipid droplets were randomly distributed in the cytoplasm and also within long expanding processes. The plasma membrane of neighbouring folliculo-stellate cells bounding a follicular cavity offered specialisations such as terminal bars (zonulae occludentes and zonulae adhaerentes) or desmosomes. Such membrane specialisations, however, were uncommon along cytoplasmic processes or between folliculo-stellate cells and granular cells.

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Fig. 1. Folliculo-stellate cells in the cat pituitary gland. Portions of two such cells limit a follicular cavity, with some microvilli. The lumen of the cavity appears empty. Junctional complexes (*JC*) are present between the folliculo-stellate cells and also between them and a granular cell. In all Figures, folliculo-stellate cells are intermingled with granular cells.  $\times 9900$ .

Fig. 2. Folliculo-stellate cells in the cat pituitary. Three such cells limit a follicular cavity containing microvilli sectioned in various planes. There are junctional complexes (*JC*) between folliculo-stellate cells. In one cell, there is a small Golgi complex (*G*).  $\times 9900$ .

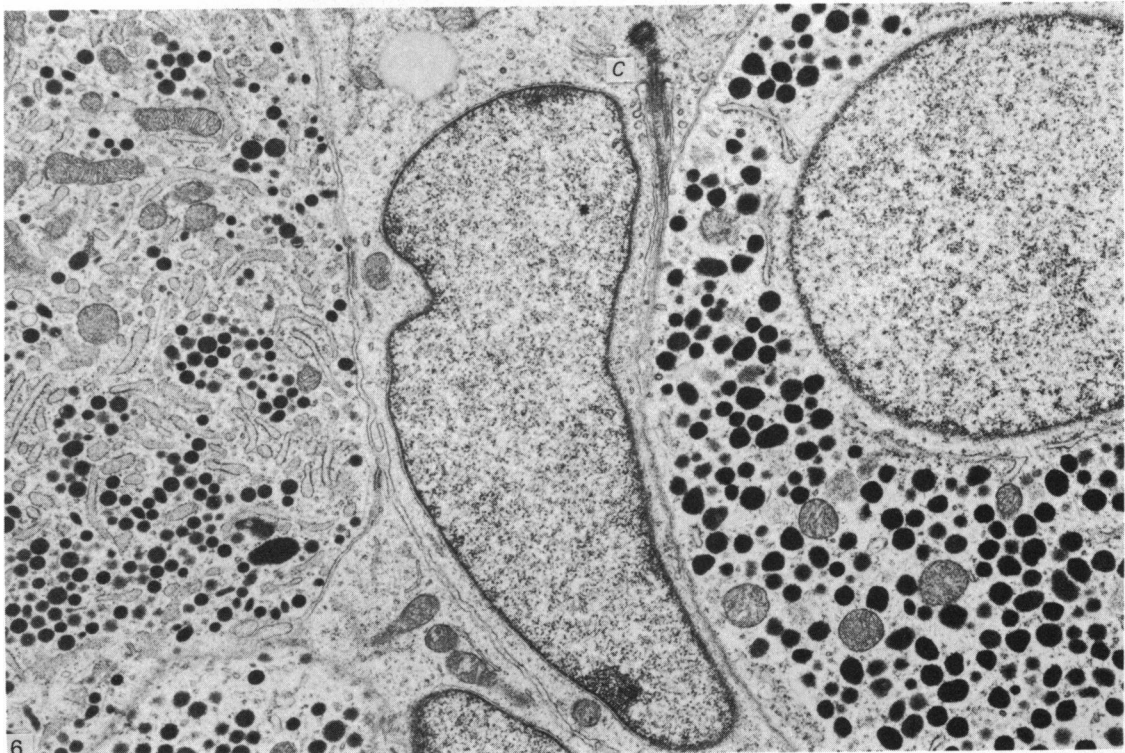
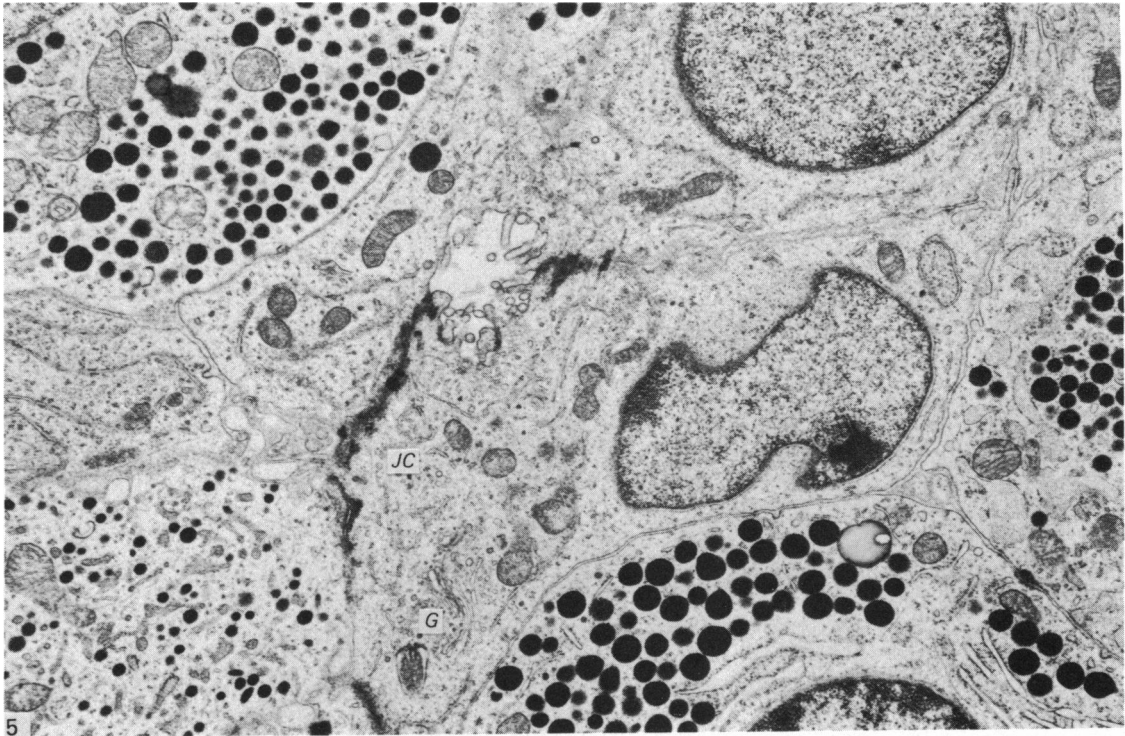




**Fig. 3.** Folliculo-stellate cells in the cat pituitary. An elongated follicular cavity with numerous microvilli. Junctional complexes (*JC*) occur between these cells and between this type of cell and granular cells. *C*, isolated centriole.  $\times 9900$ .

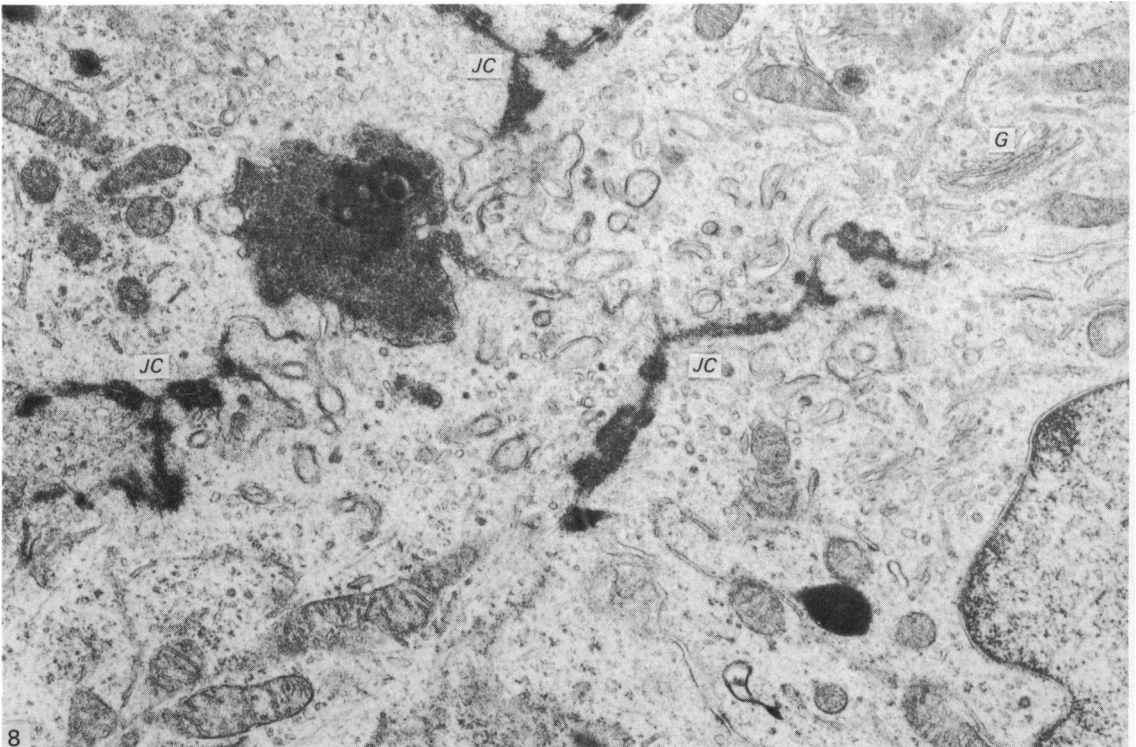
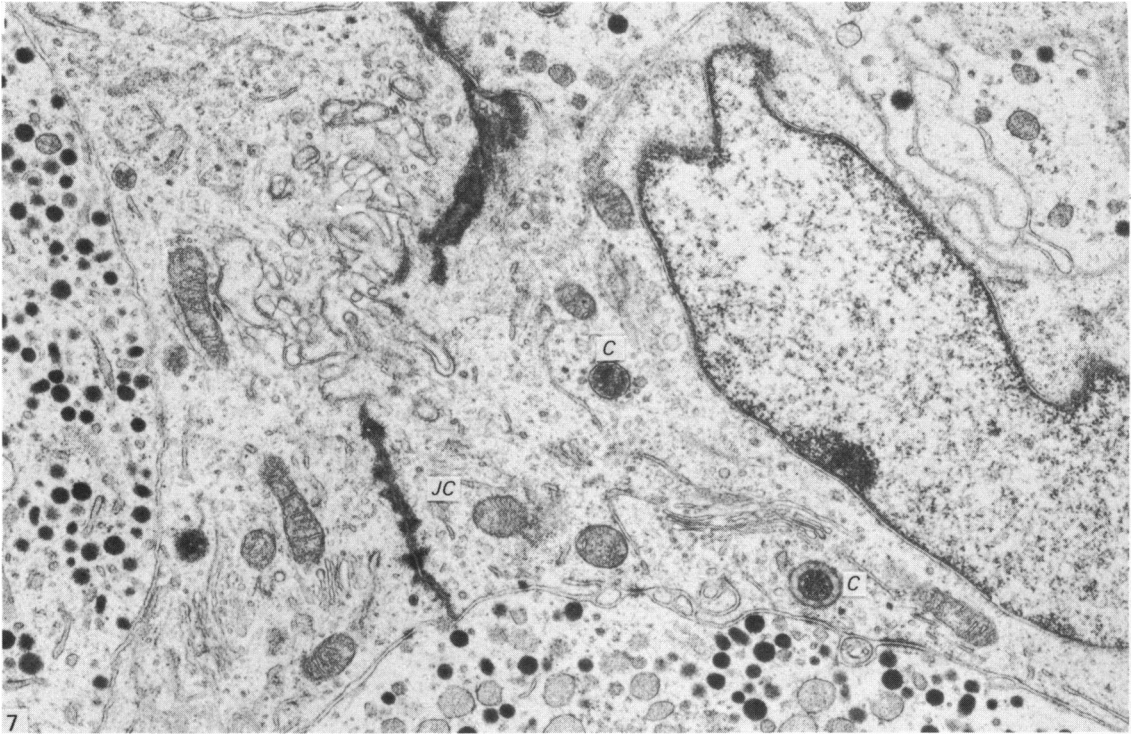
**Fig. 4.** Folliculo-stellate cells in the cat pituitary. A small portion of the follicular cavity containing microvilli. The nucleus is slightly indented and a Golgi complex (*G*) is seen. In the granular cell, note the presence of several examples of exocytosis (arrows).  $\times 9900$ .





**Fig. 5.** Folliculo-stellate cells in the dog pituitary. A small follicular cavity containing microvilli. G, Golgi apparatus; JC, junctional complexes.  $\times 9900$ .

**Fig. 6.** Folliculo-stellate cells in the dog pituitary. A portion of the cell body containing an elongated nucleus. C, cilium with a basal corpuscle.  $\times 9900$ .



**Fig. 7.** Folliculo-stellate cells in the dog pituitary. A pseudolumen with cytoplasmic interdigitations in connection with a narrow cavity containing osmiophilic material. There are cross sections (C) of two isolated cilia (9+0) in the cytoplasm. JC, junctional complexes.  $\times 28\ 700$ .

**Fig. 8.** Folliculo-stellate cells in the dog pituitary. A larger follicular cavity containing osmiophilic material. JC, junctional complexes ; G, Golgi apparatus.  $\times 28\ 700$ .

### Particular features

Each species demonstrated particular features.

In the cat (Figs. 1–4) the follicular cavity was often round or elongated and contained numerous microvilli; the lumen of the cavity appeared empty.

In the dog (Figs. 5–8) the follicular cavity had a variable appearance: in some sections, it appeared large and contained an osmiophilic dense material, while in others the narrow lumen was limited by interdigitations between adjacent folliculo-stellate cells. Sometimes close connections between mitochondria and junctional complexes could be seen.

### DISCUSSION

The presence of folliculo-stellate cells in the anterior lobe of the pituitary gland has been reported in numerous vertebrate species (Girod & Lhéritier, 1981; Vila-Porcile & Olivier, 1984). Nevertheless, the ultrastructural identification of these cells in the cat and dog pituitary is poorly documented.

In the cat, these cells have been observed by Yoshida (1962, 1966) and by Olivier, Vila-Porcile, De Brye & Nouët (1971). According to Yoshida, the hypophysial anterior lobe contains agranular cells, so-called 'peculiar chromophobes', lining pseudo-follicles. Olivier *et al.* have reported that folliculo-stellate cells in the cat consist of a network of agranular cells, sometimes stellate shaped, with a prominent glycogen content and small, dense mitochondria; the follicular cavities, of variable size and shape, contain a colloid substance.

In dog, folliculo-stellate cells have been observed in control animals by Kagayami (1965), Gale (1972) and Nunez & Gershon (1981), and in spontaneous pituitary tumours associated with Cushing's disease by Capen & Koestner (1967) and Capen, Martin & Koestner (1967). The general features of these cells in the dog pars distalis are their stellate shape and long expanding cytoplasmic processes, and the follicular organisation. Dense material or colloid in the follicular cavity is generally observed. According to an isolated report by Nunez & Gershon (1981) paracrystalline structures showing a highly regular pattern of membranes with alternating light and dark squares can be seen limited to the granular endoplasmic reticulum.

While the ultrastructural characteristics of folliculo-stellate cells have been described in specimens of all classes of vertebrates, there is little information about the functional significance of this type of cell. Various hypotheses have been presented in recent reviews (Young, 1976; Girod & Lhéritier, 1981; Vila-Porcile & Olivier, 1984) to which reference may be made. The present structural observations contribute to the ultrastructural identification of folliculo-stellate cells in two mammalian species, but provide no argument in favour of one or other functional hypothesis. Therefore, future work must determine whether folliculo-stellate cells are supporting cells or cells with some other biological activity.

### SUMMARY

Ultrastructural features of folliculo-stellate cells of the anterior lobe of the pituitary gland have been described in the cat and dog. These cells are agranular and form the lining of tiny follicles into which microvilli project. Long expanding cytoplasmic processes are intermingled with granular cells of various types without special

relationships to one cell type or another. A few features are reported which are peculiar to each species. The results are compared with those previously described.

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